APPENDIX D
SAMPLE TRACK REHABILITATION REPORT

D-1. Sample Report.

This sample report illustrates the type of information, and level of detail, suggested for an analysis of a military railroad network, in preparation for rehabilitation work. The material which explains how the work is normally conducted is included for the benefit of the reader and would not be necessary in an actual rehabilitation plan.

a. Included in this example report are:

(1) A description of track and roadway condition.

(2) A problem/defect analysis.

(3) A sequential work plan to correct the defects.

(4) Cost estimates for each item of the work plan.

b. The material in appendix C covers the structural evaluation which is normally required in a rehabilitation plan. The operational evaluation (not detailed here) should follow the guidance in paragraph 5-5.

D-2. Railroad Track Rehabilitation Report for Fort Example Summary.

a. Examination of the railroad network at Fort Example showed the following major deficiencies:

(1) Inadequate lateral and longitudinal track stability.

(2) Deteriorated track through road crossings.

(3) Turnout defects.

(4) Washouts under track.

(5) Defective and/or skewed ties in certain areas.

(6) Loose or missing track fastenings.

(7) Thick vegetation growing in some portions of track.

b. The work plan was divided into 2 phases, with a total project cost of approximately $970,000.

c. Phase 1 (to be accomplished first) covers the rehabilitation of the primary route and sidings extending from the connection with the commercial carrier to the end of the East Line. This work is estimated to cost approximately $550,000.

d. Phase 2 covers rehabilitation of most of the remainder of the track network: the south half of the Main Line, the West Line, and the North Line. This work is estimated to cost approximately $420,000.

e. The remedial work described in this report would restore the railroad network to a fully functional level, in a cost-effective manner. Remedial work has been specified only for those sections of track where the work is most needed. Tracks with no current use are not included in the plan.

f. The work plan has been designed so that when completed, the railroad network would require only normal routine maintenance to keep it fully functional for the foreseeable future.

SAMPLE RAILROAD TRACK REHABIUTATION REPORT
FOR
FORT EXAMPLE

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1. Introduction

Background

This rehabilitation plan was prompted by reports that portions of the For Example railroad network were in a general deteriorated condition and that results of the structural evaluation program indicated structural deficiencies in several stretches of track. These conditions were confirmed by the team performing the track assessment contained in this report.

Objectives

The objectives of this report are to:

(1) Document the track and roadway deficiencies found during the recent field inspection, both by type and extent.

(2) Propose corrective measures.

(3) Provide cost estimates for budget planning.

The corrective work included in the plan is intended to restore the railroad network in a cost-effective manner. Thus, not all sections of ;rack in the network are included in the plan, and each type of remedial work is specified only for ;hose sections most in need. Further, corrective work is specified only to the extent which will restore the long term function of the track. Tie replacement estimates are based on improving tie condition to the point where installation trackage can function well for five years before the next tie replacement program is needed.

Approach

A 3-person team visited the installation to examine the railroad network. During this visit, all track (except the short piece leading to the old coal/gravel chute) was examined by walking in3pection, and all primary routes were traveled

with the installation's 120-ton locomotive. In addition, those who were familiar with the track were interviewed about deficiencies they had observed and about track work performed in recent years.

Scope

This report is intended to assist in the preparation of contract specifications for remedial track work. Neither the field investigation nor this report is intended to cover every detail required for proper restoration of the railroad network, nor is this report intended to be a substitute for a complete statement of work and specifications. There are, in fact, several items noted that will require additional examination and decisions before a complete and final remedial work plan can be established.

Accompanying this report are both general and detailed track maps and photographs (with notes) showing portions of the railroad network and representative defects.

2. Operational Evaluation

This topic should be covered according to the guidance in paragraph 5-5.

3. Description of Network and Track Condition.

Introduction

The railroad network connects with the (Railroad Name) Railway about 10 miles east of (City, (State). Of the 19.95 miles of track, 9.62 miles are primary routes, 3.43 miles are in the classification yard, and 6.90 miles are loading and storage sidings and auxiliary tracks. A track diagram is shown in figure D-1, with a key to track designations in table D-1.

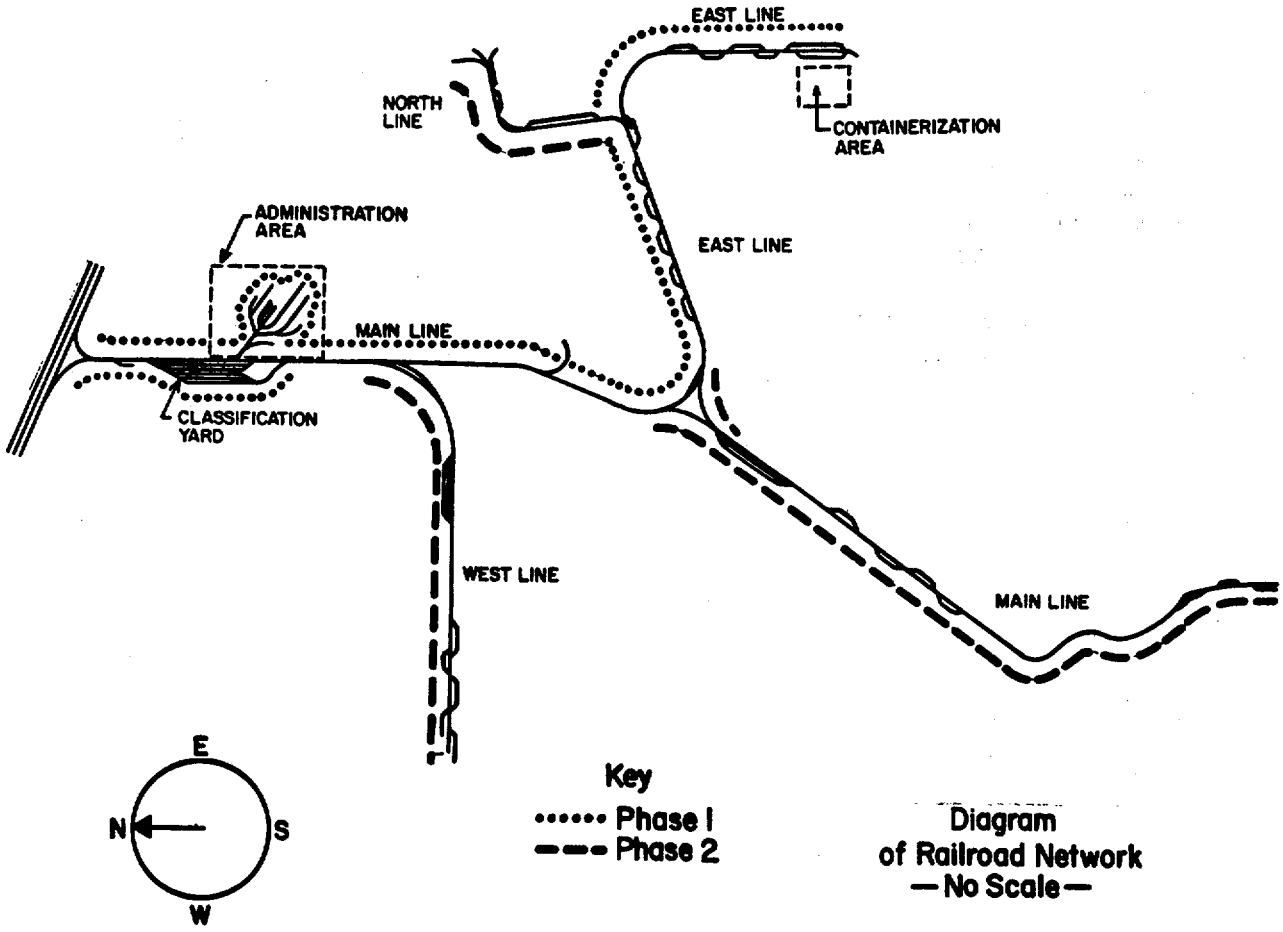

Figure D-1. Track Diagram for Fort Example.

Table D-1. Key to Track Names and Station Locations.

Letter Prefix	Track Type or Area
M	Main Line
E	East Line
W	West Line
N	North Line
A	Administration Area
P	Sidings serving loading ramps
S	Sidings serving buildings A through L
X	Miscellaneous spurs or sidings
Y	Wye tracks
2-14	Tracks in the Classification Yard.

Incoming cars are generally brought to the classification yard by the commercial carrier. There, one of the two installation locomotives will pick up the cars and deliver them to the appropriate area for loading or unloading. These cars are then brought back to the yard to be picked up by the commercial carrier. Below is a description of the railroad network, by component, reflecting conditions found during the investigation.

Rail

a. Description: 80% of the rail is 90 lb. (weight per yard of length) and manufactured between 1909 and 1924. The remaining 20% is 85 lb. The 85 lb. rail is primarily in Tracks 4 through 14 of the classification yard, the end of the North Line, and on Track A5 in the Administration Area (leading to the engine house). All rail was manufactured before the control cooling process was in use. (The control cooling process, now standard practice, greatly reduces the formation of internal defects.) b. General Condition: The rail is generally in good condition, neither excessively or unevenly worn. Very few pieces show serious end batter or surface bending. Likewise, obvious external defects, serious corrosion (except, perhaps in crossings-where the whole rail is not visible), and breaks are rare. (Testing for internal rail defects was not done.) Plates /Fastenings

a. Plates: Almost all track has single shoulder tie plates. These are in adequate condition, with relatively few missing or defective.

b. Joints: Joint bars are in good condition, with few excessively worn, cracked, or broken. However, many bolts are missing, loose, or not fully tightened. Of those that are not fully tightened, many appear to be rusted solid with the nut.

c. Spikes: Spikes are in good condition, however some are not fully driven or have worked their way up in the last few years. Also, spikes have been frequently driven through angle bar base slots, which is no longer considered to be good practice.

d. Anchors: A portion of the primary routes have rail anchors. However, most of the anchors are far enough from the ties that they can provide no benefit in restraining longitudinal rail movement.

Ties

a. Description: Most older ties are 6" x 8" in cross section. Most of the ties installed during the tie replacement 8 years ago are 7" x 8".

b. General Condition: Tie condition is generally fair to good. Areas which did not receive ties during the last tie replacement program are generally in the worst condition.

On the Main Line, approximately between stations 200+00 and 250+00, there are many skewed, bunched, or otherwise misspaced ties.

Ballast

a. Description: Most track in the primary routes has ballast composed of a low density, finely crushed volcanic material or slag, or cinders mixed with earth. Some stretches of track appear to have no real ballast section, leaving the track essentially sitting directly on the subgrade.

During recent track work, some new ballast was applied. This ballast is crushed rock of about AREA 3 or 4 gradation and appears to be good, hard material. However, in most cases, this ballast is only a surface treatment, helping to fill in cribs (the spaces between the ties) and fill out the shoulders (at the ends of the ties).

b. General Condition: The cinder/volcanic/earth material seems to drain adequately, but apparently provides insufficient lateral or longitudinal stability to the track. (See Track Geometry section below.) Additionally, this material is not sufficiently dense and stable to resist washout from heavy rains. (See Drainage/Subgrade section below.)

Drainage /Subgrade

a. Description: While the rainfall in this area of the country is not high, much of the rain comes in short, heavy periods, resulting in flash floods and washouts. Culverts at the installation are generally large (as big as 72") and often of double pipe arrangement, not only to accommodate sudden heavy flows, but also the debris that is swept along by the water.

The track is built on a sandy subgrade, and is generally elevated above surrounding ground level. There are, however, clay layers near the surface in some locations.

The large, flat areas containing tracks in the classification yard and in the Administration Area do not have a subdrainage system.

b. General Condition: Drainage is generally good, both from the track and through culverts. However, there are a few problem areas. After a heavy rain, water commonly stands in the Administration Area and in some loading sidings for quite some time. Also, due to the large amount of debris present in the storm runoff, some culverts are partially or fully blocked.

Heavy rains have also caused several small washouts on the Main Line, especially along a roughly 800 foot stretch between stations 162+00 and 170+00 and at the south end of the line.

In some places, shallow clay seams block vertical drainage, but water can usually escape adequately in lateral directions. And despite the numerous loose joint bars, the number of low joints is quite small, indicating good vertical ballast and subgrade support.

Vegetation

a. Description: Thick brush and low vegetation grow close to the track in many stretches of track, especially in loading sidings and near the ends of the primary routes.

b. General Condition: Some vegetation is very tough, and where dense growth occurs, it scrapes the sides of trains. Because of this growth, it is difficult for a person to walk next to the track in several loading sidings and at the end of the Main Line.

Turnouts

a. Description: Turnouts are either 85 or 90 lb., matching the rail in the adjacent track. All but a few are number 8 (in size) and have bolted frogs and either 11' or 16'6" switch points.

b. General Condition: Overall, turnout condition, line, and surface are adequate. However, many switches are difficult to operate and badly need cleaning, lubrication, and adjustment. Also at many switches, the heel bolts are loose and the nuts and bolts often appear solidly rusted together, which would prevent re-tightening. Some switch points are also badly chipped or broken, and other miscellaneous parts need replacement.

About half the turnouts had most or all of their ties replaced during the last tie replacement program. A few turnouts that did not get new ties do need some new ones.

Road Crossings

a. Description: Most crossings are all asphalt, with a few gravel/dirt type. There are two rubber crossings through the Main Highway near the connection with the commercial carrier.

b. General Condition: About 25 percent of the asphalt crossings are in fair to poor condition. Likewise, the track in those crossings appears to i be in fair to poor condition, typically showing loose joints and wide gage. Through a few crossings, only the slow and careful operation by the installation train crews has prevented derailments from occurring.

Track Geometry

a. Description: Track geometry describes the relative position of the two rails and track in the vertical and horizontal planes. The three primary measurements are:

(1) Alignment-a measure of lateral track deviations.

(2) Surface/Crosslevel-measures of vertical track deviations.

(3) Gage-the spacing between the two rails. (Standard Gage is 56-1/2").

b. General Condition:

(1) Alignment: Track alignment is generally fair, with some poor sections.

(2) Surface/Crosslevel: Track surface is generally adequate, although poor in places on the east half of the East Line, west half of the West Line, and spots on the Main Line. Track surface is also poor in some loading sidings. A few curves have o excessive superelevation.

(3) Gage: Track gage is generally good, with the exception of some of the road crossings, where side gage is common, and spots where skewed ties have caused tight gage.

Bridges

a. Description: There are three all-timber bridges:

Line	*Location*	*Length*	*Deck Type*
Main	19+13	64 Feet	Open
West	9+02	85 Feet	Ballast
West	40+00	122 Feet	Open

b. General Condition: These bridges were thoroughly inspected about two years previously, and found to be in good condition. During this visit, the bridges were given a brief inspection, and no obvious defects were apparent.

4. Structural Analysis

See appendix C for coverage of this topic.

5. Analysis of Major Deficiencies

Below is a description of the major track deficiencies, along with contributing factors, where appropriate. In addition, these deficiencies are referenced to the remedial actions (as described in Chapter 4) which are designed to correct them.

Inadequate Lateral and Longitudinal Track Stability

The track at the installation has, at best, a surface layer of crushed rock ballast. Most stretches have a low density mix of fine crushed volcanic material and earth filling in the spaces between and around the ties. This material does not provide adequate lateral or longitudinal track support. And as a result, track alignment is generally fair or poor, and many ties have shifted position and become skewed (not perpendicular to the rails).

To both restore and keep proper track line and surface and maintain proper tie position, a sufficient amount of good quality ballast material must be added to the track. In addition, anchors must be correctly re-applied and added where needed. Remedial Actions 2, 6, 8, 9, 12, and 13 (as listed on page 16) are designed to establish adequate lateral and longitudinal track stability.

Deteriorated Track Through Road Crossings

About 25% of the asphalt crossings are in poor condition, and likewise, so is the track in them; ties have deteriorated, track support is mushy, and joints have loosened-in some cases allowing track gage to widen to an unsafe distance.

Remedial Action 5 includes complete crossing/track rebuild, as required.

Turnout Defects

The portion of the track covered by this rehabilitation plan includes 48 turnouts. Many of these are difficult to operate, out of adjustment, and have loose or defective parts. Remedial Action 9 (Restore Turnouts) includes allowances for general turnout rehabilitation.

Washouts Under the Track

Heavy rain runoff occasionally washes out ballast and subgrade beneath the track in three areas along the Main Line. Nine small washes have occurred in the last 3 years in the Main Line between Sta. 162+80 and 169+70. One small washout occurred near Sta. 253+40, and a deeper washout just past that point.

This is one area in which further study will be required to determine the most cost effective way to either eliminate the probability of future washouts, or at least minimize possible track damage.

Remedial Action 2 includes a general plan for correcting drainage problems at these washout areas.

Skewed Ties

Some areas of the Main Line (mostly between stations 200+00 and 250+00) have skewed (crooked), bunched, and misspaced ties.

This situation is caused by the following:

(1) Low density ballast which cannot resist tie movement.

(2) Cribs (space between the ties) not fully filled with ballast, further reducing resistance to tie movement.

(3) Anchors not replaced after tie installation, or applied to only one rail (one side of the tie).

(4) Track on grades. Portions of the track are on grades steep enough to encourage longitudinal rail movement, and thus also, tie movement.

(5) Spikes driven in the slots in angle bar type joint bars. This is no longer considered good practice. As joints are usually staggered, rarely does a tie ever have a joint on both rails. Driving spikes into the joint bar base slots will then have the same effect as anchoring only one side of a tie.

(6) Ties with incorrect spiking pattern, present in some of the older ties. (While this incorrect pattern does not actually cause tie skewing, it does encourage it.)

(7) Some ties appeared to have been installed crooked.

Remedial Action 7 provides for repositioning skewed and misspaced ties, and Remedial Action 10 will help prevent future tie movement.

Loose or Missing rack Fastenings

Numerous rail joints have loose or missing bolts, and several joints (at least 12 noted during the inspection) have both bolts in one rail missing.

Remedial Action 8 calls for tightening all joints and replacing defective bolts and joint bars.

Vegetation In or Near the Track

Scattered locations along primary routes and loading sidings have thick brush growing close to the track, and in some cases, in the ballast section. This vegetation must be removed before any track work can be performed.

In addition, sufficient herbicide needs to be applied soon after completion of track work to prevent future brush growth.

Remedial Actions 1 and 13 cover the removal and future prevention of brush growth.

6. Recommendations and Cost Estimates for Remedial Work

General

This section presents a general plan for correcting the majority of track deficiencies. The plan is organized as a list of 14 remedial actions, numbered in general work sequence order. The cost estimates for each remedial action are broken down between Phase 1 (to be done this year) and Phase 2 (to be done next year). A cost estimate summary is shown in Table 2.

Phase 1 and Phase 2 include the following trackage:

Phase 1

-Main Line from connection with the commercial carrier (Sta. 0+00) to East Junction (Sta. 119+81).
-Track Y1 and Classification Yard tracks 2-5.
-Administration Area tracks A1-A8.
-East Line and sidings from Origin (Sta. 0+00) to End (Sta. 120+56).

Phase 2

-Main Line and sidings from East Junction (Sta. 119+81) to End (Sta. 263+97), and track Y2.
-West Line and sidings from Origin. (Sta. 0+00) to End (Sta. 75+06).
-North Line and sidings from Origin (Sta. 0+00) to End (Sta. 47+96).

The work plan and estimates are for restoration of the majority of the railroad network. However, not all remedial actions are intended to be carried out on all trackage. Within the description of each remedial action, the intended work limits are listed, where appropriate. Generally not included in the work plan are Classification Yard tracks 6-14 (the far west tracks), tracks X1 through X5, Administration Area track A9 (to the old coal/gravel chute), and track P5 (at the end of the West Line). These tracks, while required for mobilization, are not in regular use.

Remedial Actions

A cost estimate summary of the remedial actions is shown in table D-2.

Table D-2. Cost Estimate Summary

REMEDIAL ACTION No.	Description	PHASE 1	PHASE 2	TOTAL
1	Remove Vegetation	$1,200	$2,400	$3.600
2.	Restore Drainage	15,000	35,000	50,000
3	Rail Defect Inspection	5,000	--------	5,000
4	Replace Defective Rail	13,600	13,600	27,200
5	Rebuild Crossings	29,950	33,470	63,420
6	Tie Replacement	140,000	100,000	240,000
7	Respace Ties	3,250	8,125	11,375
8	Tighten Bolts/Spikes	18,700	18, 700	37,400
9	Restore Turnouts	19,800	12,150	31,950
10	Rail Anchors	33,580	25,200	58,780
11	Unload Ballast	147,640	86,060	233,700
12	Surface Track	55,200	32,175	87,375
13	Herbicide Application	3,200	2,600	5,800
14	On-Site Inspection	12,000	12,000	24,000
	Subtotal	$498,100	$381,500	$879,600
	10%	49,810	38,150	87,960
		547,910	419,650	$967,560

NOTES

1. PHASE 1 covers the primary route from connection with the commercial carrier to the end of the East Line, Admin, Area, and Tracks 2—5 of the Classification Yard.

2. PHASE 2 covers the remainder of the Main Line (East Jct. To End), West Line, and North Line.

(1) Remove Vegetation

This should be the first step, to ensure that the track is fully accessible for other track work and that large amounts of vegetation will not be buried in the track during ballast unloading.

Vegetation removal can be accomplished with the plow and brooms of a ballast regulator, supplemented by laborers with brushcutters.

Phase	*Mileage*	*$ Estimate*
1	1.2	1,200
2	2.4	2,400
Total	3.6 mi.	$3,600

Note: Unit Cost = $1,000/Mile

(2) Restore Drainage

It is essential that proper drainage be provided and maintained to prevent roadbed deterioration and track washouts. While drainage of the track network is mostly satisfactory, some general maintenance is needed, with a few areas that require serious attention.

This section provides a rough allowance for the following drainage work:

(a) Excavator, dump trucks, backhoe, and laborers reshaping ditches and cleaning culverts.

(*b)* Grading in the Administration area to keep water from standing within the roadbed.

(*c)* Installation of culverts and related earthwork in washout areas on the Main Line.

Due to the nature of the drainage in the Administration Area and in the washout areas, it may not be practical to implement a solution which will entirely correct the problems. A plan which will greatly improve the situation may suffice.

Especially after heavy rains (such as were experienced last summer), water stands in the track in the Administration Area. Apparently, a drainage system was never installed here, and providing one now may be quite expensive.

It is recommended that consideration be given to at least providing some grading so that water will tend to flow away from the track into adjacent lowered areas. While this solution will not eliminate the standing water in this area, it could at least prevent it from standing in the track, where it would do the most damage.

In selected areas along the Main Line (especially between Sta. 162+80 and 169+70) ballast and subgrade have been washed out from beneath the track on several occasions. These areas are located in the natural drainage path of heavy rain runoff. While preventing all runoff from reaching the track may not be affordable, it is recommended that remedial work be considered which will at least prevent the water that does reach the track from causing any roadbed damage. Such work might include the following:

(1) Install a culvert (perhaps double pipe) beneath the track, at the center of the washout area. Grade adjacent area to channel water through the culvert. Place large rock near the culvert approach to prevent erosion.

(2) Construct an interceptor berm, or other obstacle, in the drainage path to break the force of a heavy runoff.

(3) Increase the ballast shoulder in the washout areas to 12".

This may provide additional resistance against damage by water that does reach the track.

Any drainage work that may directly disturb the track should be accomplished before track work begins.

Phase	*$ Estimate*
1	15,000
2	35,000
Total	$50,000

(3) *Internal Rail Defect Inspection*

Since no record of internal rail defect inspection exists, and all rail was manufactured before the use of controlled cooling (1933), an inspection for the presence of internal rail defects should be made over the entire railroad network.

Phase	*Mileage*	*$ Estimate*
1	17	5,000
2	-	-
Total	17 mi.	$5,000

Note: Rail defect testing is priced per day plus travel costs, rather than by mileage. Phase 1 includes inspection of all track in the rehabilitation plan. In addition to cost effectiveness, inspection of all rail as soon as practical will permit an accurate determination of the quantity of rail that requires replacement.

(4) Replace Defective Rail

This estimate is an allowance for replacing the defective rails that may be found during an internal defect inspection.

Phase	Number of Rails	$ Estimate
1	34	13,600
2	34	13,600
Total	68	$27,200

Note: Unit Cost = $400/rail. Estimate based on 33-foot sections of 90 lb. rail, and allowance of 4 defective rails/mile.

(5) *Rebuild Road Crossings*

In road crossings which require replacement, the track often needs to be completely rebuilt. In addition, conventional rail joints are often replaced with welded joints to eliminate the need for future joint maintenance (which usually requires tearing out at least part of the crossing surface). Welding joints in a crossing is especially recommended in areas with heavy truck traffic and in crossings in main running tracks. The rebuilding of crossings can start any time before the ballast and surfacing operations.

These estimates cover crossing replacements, as listed in table D-3. Three types are specified: complete track rebuild with timber/ asphalt surface, timber/asphalt surface replacement, and timber/gravel surface replacement.

Table D-3. Road Crossing Repair/Rebuilding.

Phase	Line	Centerline Location	Crossing Length	Rebuild Type
1	Main	24+53	24’	CA
		77+55	42’	CA
		113+65	87’	CA
	East	10+94	33’	A
		46+46	31’	A
		65+81	30’	CA

Table D-3. Road Crossing Repair Rebuilding-Continued.

Phase	Line	Centerline Location	Crossing Length	Rebuild Type
2	Main	173+20	25'	A
		193+31	22'	A
		204+20	15'	G
		258+09	30'	A
	West	4+45	18'	G
		37+56	21'	A
		45+49	19'	A
	North	5+75	85'	CA
		35+63	30'	A
		44+95	67'	CA

SUMMARY

Phase	*Rebuild Type*	*Number of Xings*	*Footage*	*Number Welds*
1	CA	4	183'	7
	A	2	64'	4
2	CA	2	152'	8
	A	6	126'	11
	G	2	33'	2

Rebuild Ape Key
CA-Timber/Asphalt crossing surface with complete track rebuild.
A--Timber/Asphalt crossing surface replacement.
G--Timber/Gravel crossing surface replacement.

The timber portion of the crossing surface refers to timber head boards installed along the gage side (or both sides) of the rail. Timber head boards help keep the flangeways clear, reduce intrusion of road material into the track, and lessen the lateral rail impact from vehicle traffic.

Phase	*$ Estimate*
1	29,950
2	33,470
Total	$63,400

Note: The following unit costs were used for crossing work:

(1) Timber/Asphalt crossing with complete track rebuild, $125/foot.
(2) Timber/Asphalt crossing surface replacement, $50/foot.
(3) Timber/Gravel crossing surface replacement, $25/foot.
(4) Joint Welds, $350 each.

(6) Tie Replacement

This estimate provides for ties primarily in the areas that were not covered in the previous tie replacement program. Generally, the limits are the same as specified for ballast and surfacing. The number of ties estimated is intended to allow the installation track to. maintain sufficient tie condition for 5 more years before another tie program is required. (Although during the next 5 years, some spot tie replacement will probably be needed).

Included in the estimate for each phase is an allowance for 400 ties in the loading tracks (and the containerization terminal on the East Line to be done in Phase 1) and for 100 ties which drop during surfacing and are in too poor a condition to be respiked.

Exact tie counts should be made when preparing the final plans.

Phase	*Numer of Ties*	*$ Estimate*
1	3500	140,000
2	2500	100,000
Total	6000	$240,000

Notes: (1) Unit Cost estimate = $40/Tie.
(2) The tie spacing at the installation averages 20', which equals 3,168 ties/mi.

(7) Respace Ties

During this remedial action, the many skewed and misspaced ties will be properly repositioned. This work also includes raising ties that dropped during the track raise and replacing occasional defective ties that cannot be re-spiked.

This estimate covers labor and machine costs for tie respacing.

Phase	*Mileage*	*$ Estimate*
1	2.50	3,250
2	6.25	8,125
Total	8.75	$11,375

Notes: (1) Unit Cost estimate = $1,300/Mile.
(2) For Phase 2, tie respacing not required on Main Line from Sta. 154+00 to Sta. 200+00. This work is also only needed over approximately half of the North Line.

(8) *Tighten and Replace Track Bolts/Drive High Spikes*

Due to numerous loose rail joints, a bolt tightening machine should tighten all track bolts. During this operation, all defective bolts and joint bars should be replaced.

Along with bolt tightening, all high spikes should be driven down and all defective spikes replaced. This will minimize the number of ties that drop down when the track is raised during surfacing.

However, it is not recommended to either pull any spikes driven in the slots of angle bar type joint bars, or pull or add any spikes in' ties with an incorrect spiking pattern. The combination of tie straightening/respacing, additional ballast, and application of rail anchors included in this rehabilitation plan should be sufficient to prevent any future tie movement due to incorrect spiking.

Further, there would be significant potential for

long term tie damage due to pulling spikes (even if old holes are plugged).

Both operations (for bolts and spikes) should be performed prior to any ballast unloadng or surfacing.

Phase	*Mileage*	*$ Estimate*
1	8.5	18,700
2	8.5	18,700
Total	17.0 mi.	$37,400

Note: Unit Cost estimate of $2,200/Mile based on:

(1) Bolt tightening, $1,500/mi.

(2) Allowance for extra bolts, $2.50 each, 120 per mi, or $300/mi.

(3) Allowance for extra spikes and miscellaneous work, spikes @ $1.00 each, total allowance @ $400/mL

(9) Restore Turnouts

This work includes: surfacing turnouts; replacing defective parts; grinding switch points and frogs as needed; and cleaning, adjustment, and lubrication.

Table D-4 provides a detailed listing of turnouts included in Phases 1 and 2, along with a rough approximation of switch tie requirements and switch point replacements. (Exact requirements should be determined for inclusion in contract work statement).

Phase	*Number of Turnouts*	*$ Estimate*
1	10	19,800
2	12	12,150
Total	22	$31,950

Notes: (1) Unit Cost varies with work required. Estimates based on:

(a) $1050/turnout for surfacing, miscellaneous parts, and cleaning and adjustment.

(b) $50/switch tie, installed.

(2) Estimate allows for 75 switch ties in Phase 1 and 126 in Phase 2. (See Table 4).

(3) Estimate allows for 7 switch points to be replaced in Phase 1 and 6 in Phase 2. Cost per point (installed) is estimated to be about $800 for a 16’6’ point.

Table D-4. Turnout Rehabilitation

Phase	Line	I.D. Number	Loca-tion	Direction	Switch Tiec Requirement	(1) Point Replacement
1	MAIN	M03	24+67	RIGHT	8	L R
		M04	39+88	LEFT	-	R
		M05	40+21	LEFT	-	LR
		M07	44+84	LEFT	12	-
	EAST	E03	3+64	LEFT	10	-
		E04	14+49	LEFT	8	-
		E08	36+15	RIGHT	20	-
		E10	42+77	LEFT	8	-
		E12	49+60	RIGHT	8	-
		E17	117+95	LEFT	-	LR
					74	7
2	MAIN	M13	134+51	RIGHT	15	-
		M15	155+02	LEFT	5	-
		M16	162+11	LEFT	5	-
		M17	170+55	RIGHT	9	L R
	WEST	W09	69+23	RIGHT	8	L
		W11	70+89	LEFT	8	-
		W12	71+54	RIGHT	8	R
	NORTH	NO1	8+78	RIGHT	12	-
		NO4	23+03	LEFR	22	L
		NO5	25+80	RIGHT	11	L
		NO6 (2)	32+47	LEFT	9	-
		NO7 (3)	32+87	RIGHT	14	-
					126	6

Notes: (1) L = Left Point, R = Right Point

(2) One switch rod missing

(3) Cracked frog

(10) Apply Rail Anchors

After new ties have been installed and skewed and misspaced ties properly repositioned, rail anchors should be applied.

This estimate calls for every 5th tie to be box anchored (have 4 anchors applied), with anchoring of primary routes only (no sidings). See Notes 2 and 3 below for intended anchoring limits.

Phase	*Mileage*	*$ Estimate*
1	4.77	33,580
2	3.58	25,200
Total	8.35 mi.	$58,780

Notes: (1) Unit cost estimate of $7,040/Mile, based on:
- (a) Purchase cost of $2.00/anchor.
- (b) Installation cost of $1.25/anchor.
- (c) 2,560 anchors/mi.
- (d) Assumption that 25% of required anchors can be salvaged from existing material.

(2) For Phase 1, anchors are to be applied along the Main Line from Railroad connection (Sta. 0+00) to East Junction (Sta. 119+81); East Line from Origin (Sta. 0+00) to End (Sta. 120+56); and along Y1.

(3) For Phase 2, anchors are to be applied along the Main Line from East Junction (Sta. 119+81) through Sta. -194+00; West Line from Origin (Sta. 0+00) through Sta. 70+89; and North Line from Origin (Sta. 0+00) through Sta. 43+63.

(4) Anchoring near the two open deck bridges (M 19+13 and W 40+00) should be done as follows: no anchors on track on the bridge; box anchor every 3rd tie for 2 rail lengths (about 66 feet) off either end of the bridge.

(11) Unload Ballast

Once the track is clear of excess vegetaion, all bolts in place and tight, high spikes driven, and track in crossings rebuilt, the track is ready for new ballast to be applied. Ballast and surfacing locations are shown in table D-5.

Table D-5. Ballast and Surfacing Locations

Location	Footage
Phase 1	
Main	
3+87 (S. end Rt. 40 Xing) to 19+13 (N. end bridge)	1,526
24+65 (S. end new Xing) to 45+50 (N. end scale track)	2,085
47+51 (s. end scale track) to 119+81 (east Junction)	7,230
	10,841
East	
0+00 (East Junction) to 120+56 (End)	12,056
Si8dings (except X3, X4)	6,586
	18,642
Yard	
Tracks 2-5	5,823
Admin	
Track Al-up to 5+61 (Building 9)	561
Track A5-up to 14+40 (to engine house)	1,440
Track A6-up to 9+52 (end)	952
Track A--up to 6+00 (to scrap bin)	600
	3,553
Total Phase 1 Footage (7.36 mi.)	38,859
Phase 2	
Main	
119+81 (East Junction) to 194+01	7,420
257+79 to 263+97 (End)	618
	8,038
West	
0+00 to 75+06 (End)	7,506
North	
0+00 to 48+73	4,873
Tracks SASE	2,237
	7,110
Total Phase 2 Footage (4.29mi.)	22,654

This estimate is for sufficient ballast to give the track a 3-inch raise, fill in shoulders and cribs, and pull up any track sags. It includes the costs of purchasing the ballast material, delivery to the work site, and distribution along the track.

The mileages indicated correspond to the surfacing footages, as shown in table D5.

Phase	*Quantity*	*Mileage*	*$ Estimate*
1	10,100 tons	7.36	147,640
2	5,900	4.29	86,060
Total	16,000 tons	11.65 mi.	$233,700

Notes: (1) Unit Cost estimate of $20,060/Mile based on:

(a) Ballast quantity of 0.2 cu. yd per track foot (1,056 cu. yds/mi.) @ $10.00/cu. yd. delivered to site, or $10,560/mi.

(b) Unloading operation @ $9,500/mile.

(2) Locations for ballast unloading are the same as for surfacing (Remedial Action 7).

(3) 1 cubic yard of ballast weighs approximately 1.3 tons.

(4) Ballast needed for rebuilding track in crossings is included in the estimate for rebuilding road crossings.

(5) Estimate includes AREA standard 15% allowance for ballast waste and loss.

(12) Surface Track/Reshape Ballast Section The main surfacing operation includes:

(a) Lifting the track 3 inches.

(b) Restoring proper track line and surface.

(c) Reshaping the ballast section.

The limits for this work are as shown in table D-5.

During the final design process the sidings serving the loading docks and magazine standards should be checked to ensure that there is proper horizontal and vertical clearance between the track and the loading platform. Any corrections that are required should be done during track surfacing.

Phase	*Mileage*	*$ Estimate*
1	7.36	55,200
2	4.29	32,175
Total	11.65 mi.	$87,375

Notes: (1) The Unit Cost estimate for surfacing is $10,560/Mile. Included in this cost is the following work:

(a) Raising the track 3".

(b) Plowing new ballast back into the track to fill in up to the tops of the ties.

(c) Reshaping the ballast section.

(d) Sweeping the track.

(2) For Phase 1, estimate assumes no track raise through the track scale, and also assumes that track will be raised to level of existing crossings in the sidings along the East Line (Buildings A-F).

(3) For Phase 2, a 12' shoulder should be provided in the track washout areas along the Main Line.

(13) Herbicide Application

Once the track work is complete, all track should be sprayed to prevent the growth of weeds in the ballast section.

While vegetation spraying should be done at least once per year, this estimate is for one initial heavy application over a 16-foot wide path (8 feet from the center line of track on both sides).

Phase	*Mileage*	*$ Estimate*
1	10.7	3,200
2	8.5	2,600
Total	19.2 mi.	$5,800

Notes. (1) Contract herbicide application is priced per day. As a rough estimate, a unit cost of $300/Mile was used.

(2) Phase 1 to include all Classification Yard tracks.

(14) Quality Control Inspection

Although listed last, quality control inspection is an essential element for a successful track rehabilitation. It is an effective means of assuring that all work reflects good workmanship and is performed according to the contract specifications.

Phase	*$ Estimate*
1	12,000
2	12,000
Total	$24,000

Notes. (1) Inspection cost estimate based on $35/Hour basic labor and overhead charge, or $280/Day, and $100/Day subsistence expenses. Total = $380/Day.

(2) Allowance for travel to and from site of one round trip/week = $500.

(3) Total Inspection Cost/Week = $2,400.

(4) Phase 1 and 2 estimated to require 5 weeks each of on-site inspection

7. Conclusions and recommendations

Proper track restoration will involve remedial work which requires special attention. It is essential that this work be done by skilled workers, with knowledgeable and attentive supervision.

As indicated in the report, there are still some areas that need further examination before detailed contract specifications can be made, particularly in the improvement of drainage in areas where track washouts have occurred. These additional determinations should be included as part of the final design process.

If the design work is to be contracted to an outside organization, it is recommended that a single design/inspection package be considered. Having the track work designed and inspected by the same organization has great potential for

improved quality control and accountability throughout the project.

To further clarify the work plan and contract specifications, the work requirements (by type and lcoation) should be marked in the field, whenever practical. This might include: marking with paint lose switch ties which need replacement, setting flags or stakes to indicate the limits where extra shoulder ballast is required, painting a code at each road crossing to indicate which type of reconstruction is to be done, and any other indicators which may help guide the field work.